

# A LOWER JURASSIC FLORA FROM THE UPPER MATANUSKA VALLEY, ALASKA.

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The material upon which this paper is based was collected by Dr. George C. Martin, R. M. Overbeck, and J. B. Mertie, jr., of the United States Geological Survey, during the field season of 1913. The general location of the fossil collections, together with the available structural and stratigraphic data, is described in the following notes, which Doctor Martin has kindly prepared:

The fossil plants were obtained from four localities, all situated in a small area lying south of the east fork of Boulder Creek and north of Anthracite Ridge. These localities are in the eastern part of the Talkeetna Mountains, or in the upper Matanuska Valley, Boulder Creek flowing westward into Chickaloon River, which is the largest northern tributary of the Matanuska.

The Lower Jurassic rocks of the Matanuska Valley and adjacent areas have a wide geographic extent and constitute a very important stratigraphic and structural element in the geology of the eastern Talkeetna Mountains. These rocks were described by Paige and Knopf<sup>1</sup> as "lower Middle Jurassic rocks" (including only the volcanic members as described in the text, but the whole of the "Middle Jurassic andesitic greenstones, etc.," as represented on the map). They were tentatively correlated by Brooks with the Skwentna<sup>2</sup> group, which he referred to the lower Middle Jurassic on the basis of Paige and Knopf's assignment of their Matanuska Valley rocks. They include the "Lower Jurassic rocks" described by Martin and Katz,<sup>3</sup> and by Martin and Mertie.<sup>4</sup>

These rocks include lavas, agglomerates, breccias, and tuffs, interbedded with lesser volumes of sandstone and shale. They are composed chiefly of water-laid volcanic detritus. Their thickness is probably several thousand feet, but can not be accurately estimated on account of the complex structure and the lack of recognizable horizons. The position of the plant-bearing beds within the formation has not been determined. These rocks carry also an abundant marine invertebrate fauna which Stanton regards<sup>5</sup> as probably of Lower Jurassic age, and as probably equivalent to that

<sup>1</sup> Paige, Sidney, and Knopf, Adolph., *Geologic reconnaissance in the Matanuska and Talkeetna basins, Alaska*, U. S. Geol. Survey Bull. 327, 1907, pp. 16-19.

<sup>2</sup> Brooks, Alfred H., *The Mount McKinley region, Alaska*, U. S. Geol. Survey Prof. Paper 70, 1911, pp. 85-87.

<sup>3</sup> Martin, G. C., and Katz, F. J., *Geology and coal fields of the lower Matanuska Valley*, U. S. Geol. Survey Bull. 500, 1912, pp. 29-32.

<sup>4</sup> Martin, G. C., and Mertie, J. B., jr., *Geology of the upper Matanuska district*, U. S. Geol. Survey Bull. (in preparation).

<sup>5</sup> U. S. Geol. Survey Bull. 500, p. 31.

of the Lower Jurassic tuffs<sup>1</sup> of Seldovia. They were largely, if not wholly, deposited in marine waters, although the plants herein described are possibly indicative of temporary terrestrial conditions. The plants have been found only in one small area, but the marine invertebrates are widely distributed. The plants and the marine shells have not been found in the same bed, nor have their precise relations been determined.

Neither the basal contact of these beds nor the rocks which underlie them have been observed, these being the oldest rocks known in this district. They are overlain by Middle Jurassic beds which have yielded numerous fossils (8567), including *Sagenopteris göppertiana* Zigno, together with a great variety of marine invertebrates. The fauna of these overlying Middle Jurassic rocks corresponds closely to that of the Tuxedni sandstone<sup>2</sup> of Cook Inlet, in which *Sagenopteris göppertiana* and other plants have also been found.

The plant material from the Matanuska Valley proves to be of exceptional interest and, as so frequently happens in reconnaissance work, it is perhaps of necessity unfortunately limited in amount. The matrix containing the plants had a tendency to break up into small pieces, with the result that there is hardly an entire leaf or frond in the whole collection. In some cases the nervation is much obscured, while in others, as for instance in the fragments of *Dictyophyllum* leaves, it is retained with remarkable fidelity.

The stratigraphy and invertebrate paleontology, as set forth in the preceding paragraphs by Doctor Martin, point to the reference of these rocks to the Lower Jurassic, and it naturally becomes of interest to ascertain the bearing of the plants on this point. Following is an enumeration of the species recognized from the combined localities, the local distribution of each species being indicated under the locality number below:

Name.	6698	6699	6700	6701
<i>Cladophlebis hirta</i> ? Möller.....			X	
<i>Dictyophyllum nilssonii</i> (Brongniart) Göppert.....			X	
<i>Sagenopteris</i> ?, species.....			X	
<i>Otozamites pterophylloides</i> Brongniart MSS.....		X		X
<i>Otozamites bornholmensis</i> ? Möller.....			X	
<i>Pterophyllum rajmahalense</i> Morris.....	X			
<i>Pterophyllum aequale</i> (Brongniart) Nathorst.....	X			
<i>Ctenophyllum angustifolium</i> ? Fontaine.....	X			
<i>Nilssonia polymorpha</i> Schenk.....			X	
<i>Pagiophyllum falcatum</i> Bartolin.....			X	

As all these forms, with the exception of the unnamed *Sagenopteris*, are species previously known, they may furnish adequate information as to their age values. In the first place it may be pointed out that, although geographically related only one of the 10 forms enumerated above—namely, *Pterophyllum rajmahalense*, which has been

<sup>1</sup> Stanton, T. W., and Martin, G. C., Mesozoic section on Cook Inlet and Alaska Peninsula, Geol. Soc. America Bull., vol. 16, 1905, pp. 396-397.

<sup>2</sup> Martin, G. C., and Katz, F. J., A geologic reconnaissance of the Iliamna region, Alaska, U. S. Geol. Survey Bull. 485, 1912, pp. 59-64.

reported<sup>1</sup> from the Middle Jurassic (Tuxedni sandstone) of Cook Inlet—has thus far been detected in any of the Jurassic areas known in Alaska, though several of the genera are present. To the south, however, three species are found to be common to the Jurassic of Douglas County, Oregon, as follows: *Pterophyllum rajmahalense*, *Pterophyllum aequale*, *Ctenophyllum angustifolium*?

As these three species occur together at a single locality in the Matanuska Valley, and were not found at any of the other localities, it is not impossible that they may represent a higher horizon, which would place them more in accord with the Oregon Jurassic.

The first of these species is reported by Fontaine to be one of the most abundant forms at the Oregon localities. It was first described from the Rajamahal series of India, in beds believed to be of Liassic age, while the Oregon localities are held to be of the same age as the Jurassic of Yorkshire, England—namely, Lower Oolite.

The second species (*Pterophyllum aequale*) is also one of the abundant forms in the Oregon Jurassic. It was first reported in the Rhaetic of Sweden by Brongniart, and later by Nathorst and others. Fontaine<sup>2</sup> has expressed the opinion that Nathorst has probably confused two species under this name from Sweden, one form of which is the abundant type at the Oregon localities.

There is some question about the identification of the third species (*Ctenophyllum angustifolium*), and its presence in the rocks of the Matanuska Valley has been queried. The only specimen in the collection is the fragmentary one shown in the figure (pl. 80, fig. 2), and while it is smaller than the usual Oregon form shown in Fontaine's figures, it is of the same type and may well have come from near the tip of an especially small leaf. In any event it has been thought better to refer it provisionally to this form rather than found a new species on inadequate material.

The Matanuska material undoubtedly finds its closest affinity with the material described by Nathorst, Bartolin, Möller, and others from the island of Bornholm, off the southern coast of Sweden, since all but two of the forms (*Pterophyllum rajmahalense* and *Ctenophyllum angustifolium*) are common to the two places. It should be noted that these two species have not been found at the same Alaskan localities as the other eight species. It is of course true that the identification of two or three of the Matanuska forms has been questioned, but the certainty with which certain of the other forms have been identified makes these doubtful ones the more reasonable. One of the most characteristic and unmistakable forms is the *Dictyophyllum* which genus has been reported but once before from America. Two of the varieties or forms of this species described by Nathorst are also present in the Alaskan material.

<sup>1</sup> U. S. Geol. Survey Bull. 484, p. 64, 1911.

<sup>2</sup> Fontaine, W. M., in Ward, U. S. Geol. Survey Mon. 50, p. 100, 1906.

To the best of present knowledge and belief, then, the Matanuska localities are thought to be of the same age as the Bornholm deposits, and the question only remains: What is that age? In the works of Möller, Nathorst, and others the Bornholm locality is referred to as Rhaetic or Liassic, there apparently being the same difficulty there, as in many other parts of Europe, in drawing the line between the Triassic and Jurassic. Taking everything into account in the present connection, such as the Jurassic affinity of certain of the forms, the absence of known plant-bearing Triassic rocks in Alaska, the apparently Lower Jurassic indication of the associated invertebrates, etc., all give weight to the reference of these rocks to the higher of the two alternatives. The material under consideration from the Matanuska Valley is, therefore, regarded as of Lower Jurassic (Liassic) age. This is the oldest, well-defined Jurassic flora known to the writer in North America.

It may be mentioned that the plant-bearing beds that are possibly of Lower Jurassic age have been found at Cold Bay on the Alaska Peninsula. The fossil plants obtained from these beds (lot 3109) are not well preserved and apparently include only two species which have been provisionally identified as *Glossozamites? schrenkii?* and *Pterophyllum?* species. These species probably are not identical with any of the forms here described.

#### ENUMERATION OF THE SPECIES.

##### CLADOPHLEBIS HIRTA? Möller.

Plate 81, fig. 3.

*Cladophlebis hirta* MÖLLER, Bidrag till Bornholm fossila flora, Pteridophyter: Kong. Fysiografiska Sällskapets, Handl., vol. 13, 1902, p. 30, pl. 2, figs. 23, 24; pl. 3, fig. 2.

*Occurrence*.—6700. Upper Matanuska Valley, Alaska. Crest of spur between first and second tributaries entering East Fork of Boulder Creek above its mouth. Elevation, 4,780 feet.

##### DICTYOPHYLLUM NILSSONI (Brongniart) Göppert.

Plate 82, figs. 1-4.

*Dictyophyllum nilssoni* (Brongniart) GÖPPERT, Gattungen d. fossilen Pflanzen, pts. 5 and 6, 1846, p. 119 [153].—NATHORST, Bidrag till Sveriges fossila flora, Kongl. Svenska Vetenskaps-Ak. Handl., vol. 14, No. 3, 1876, p. 25, pl. 1, fig. 14; pl. 4, figs. 6-8; pl. 5, figs. 1-5; pl. 6, figs. 2-3; pl. 7, figs. 1, 2; Beitrag e fossilen flora Schwedens, 1878, p. 14, plates and figures the same as in the preceding paper; Über *Dictyophyllum u. Camptopteris spiralis*: Kongl. Svenska Vetenskaps-Ak. Handl., vol. 41, 1906, p. 5, pl. 2; pl. 3, figs. 2-8.

*Phlebopteris nilsonii* BRONGNIART, Hist. vég. foss., 1836, p. 376, pl. 132, fig. 2.

So far as known to the writer this is the second time the presence of *Dictyophyllum* has been noted in North America. The genus was

established by Lindley and Hutton<sup>1</sup> in 1834, with *D. rugosum* from the Lower Oölite of Yorkshire, England, as the type-species.<sup>2</sup>

Since that time about 40 species have been established, among them the splendid species with which the Matanuska specimens are believed to be identical. According to Nathorst, *Dictyophyllum nils-soni* is a fairly abundant species in the Rhaetic beds at Pålshö and Hör in southern Sweden, and he has figured some magnificent examples with as many as 18 pinnules or segments. The number of segments appears to range from 6 to 9 on a side, or from 12 to 18 in the whole frond.

The Matanuska specimens, although known only from pieces of small size, give evidence of having been as large as, or even larger, than the maximum size shown in Nathorst's figures. Thus, the fragments shown in plate 82, fig. 1, might well have come from the middle of a segment similar to that shown in Nathorst's plate 2.<sup>3</sup> The nervation in the Alaskan specimens is preserved with great fidelity, as may be noted from the figures.

The Swedish specimens show such a range in size and outline that Nathorst has been induced to give them a number of form or varietal names, at least two of which are recognizable in the Alaskan material. Thus, figures 1-3 are referable to Nathorst's form *genuinum*, while figure 4 seems to be form *brevilobatum*.

*Occurrence*.—6700. Upper Matanuska Valley, Alaska. Crest of spur between first and second tributaries entering East Fork of Boulder Creek above its mouth. Elevation, 4,780 feet.

#### SAGENOPTERIS?, species.

Plate 81, fig. 2.

The collections from the Matanuska region include the fragment here figured, which represents the apical portion of a small very obtuse leaf. The fragment is about 4 cm. long and a little less than 2 cm. wide, and gives little evidence of an increase in size toward the base. The substance of the leaf is extremely thick and the nervation, with the exception of the midrib, is made out with difficulty. The midrib is very slender, but appears to reach quite to the apex. The

<sup>1</sup> Lindley and Hutton, Foss. flora Great Britain, vol. 2, 1834, pl. 104.

<sup>2</sup> In this connection it may be worth while to point out an error into which Seward has fallen in considering the type-species. In his Jurassic flora of the Yorkshire Coast, 1900, p. 123, he says: "In 1828, Brongniart proposed the name *Phlebopteris phillipsi* for the plant figured by Lindley and Hutton in 1834 as *Dictyophyllum rugosum*; the latter name is quoted by the French author as a synonym, although the plant was not described in the *Fossil Flora* until 1834. We must assume, therefore, that Brongniart saw the description by the English authors some years before Lindley and Hutton published their work." As a matter of fact Brongniart's *Histoire*, although bearing the title-page date of 1828, was actually published in parts extending over the period from 1828 to 1838, and the parts 10 and 11, covering pages 337 to 416, and plates 131 to 134, within which falls the description of *Phlebopteris phillipsi*, was not issued until 1836, as worked out by Zeiller in his Valenciennes flora, 1888, p. 702. This shows that Brongniart must have had Lindley and Hutton's work before him, and his *Phlebopteris phillipsi* naturally and legitimately becomes a synonym of *Dictyophyllum rugosum*.

<sup>3</sup> Kongl. Svenska Vetenskaps-Ak. Handl., vol. 41, 1906, pl. 2.

nerves emerge at an angle of about 45, curve slightly in passing outward, and are often forked. There is also some evidence that the nerves may anastomose, but the leaf is so thick and leathery that this point is obscured.

The generic reference is somewhat uncertain, but in all reasonable probability it belongs to *Sagenopteris*. It is quite unlike the species just described, but does resemble a number of well-known forms. It has been thought best, however, considering its fragmentary nature, not to give it a specific name.

*Occurrence*.—6700. Upper Matanuska Valley, Alaska. Crest of spur between first and second tributaries entering East Fork of Boulder Creek above its mouth. Elevation, 4,780 feet.

#### OTOZAMITES PTEROPHYLLOIDES Brongniart.

##### Plate 79.

*Otozamites pterophylloides* Brongniart MSS., SCHIMPER, Pal. Vég., vol. 2, 1870, p. 173.—SAPORTA, Plants Jurassique, vol. 2, 1875, p. 152, pl. 104, figs. 1, 2; pl. 105; pl. 106, figs. 1, 2; pl. 107; pl. 108, fig. 1; pl. 110, fig. 3.—BARTOLIN, Nogle i den bornholmske Juraformation forekommende Planteforsteninger, Bot. Tidsskr., vol. 19, 1894, p. 94, pl. 2, fig. 7.—MÖLLER, Bidrag till Bornholms fossila flora, Gymnospermer, Kongl. Svenska Vetenskaps-Ak. Handl., vol. 36, 1903, p. 13, pl. 1, fig. 19; pl. 3, fig. 1; pl. 7, fig. 15.

This species is represented by several examples, the largest and best being the one figured. In size and shape of the leaflets it appears to agree most closely with several of the figures given by Saporta in his *Plants Jurassique*,<sup>1</sup> being if anything slightly larger than the French specimens. The examples referred to this species by Möller have the leaflets narrower and more acute than the Matanuska specimens, but the nervation is apparently the same in both.

*Occurrence*.—6699. Upper Matanuska Valley, Alaska. Talus from cliff about 1 mile up the next to the lowest creek entering the East Fork of Boulder Creek from the south.

6701. Float from about a third of a mile below locality 6700.

#### OTOTZAMITES BORNHOLMIENSIS Möller?

##### Plate 81, figs. 5, 6.

*Otozamites bornholmiensis* MÖLLER, Bidrag till Bornholms fossila flora, Gymnospermer, Kongl. Svenska Vetenskaps-Ak. Handl., vol. 36, 1902, p. 12, pl. 2, figs. 1-7.

The two fragments figured are all that were contained in the Matanuska collection, and while not very well preserved they appear to be the same as *Otozamites bornholmiensis* of Möller, from the island of Bornholm. They differ slightly in being a little larger and in having the pinnules more distinctly alternate, and for this reason the identification has been questioned. The nervation is very obscurely pre-



served, but so far as can be made out it is the same as in the Swedish specimens.

*Occurrence*.—6700. Upper Matanuska Valley, Alaska. Crest of spur between first and second tributaries entering East Fork of Boulder Creek above its mouth. Elevation, 4,780 feet.

**PTEROPHYLLUM RAJMAHALENSE Morris.**

Plate 80, fig. 1.

*Pterophyllum rajmahalense* MORRIS in Oldham and Morris, Foss. Fl. Gondwana System, vol. 1, 1863, p. 25, pl. 13, figs. 3-5; pl. 14; pl. 18, fig. 2.—FONTAINE in Ward, Status Mesozoic floras of the United States, 2d paper, U. S. Geol. Survey Mon. 50, 1905, p. 102, pl. 21, figs. 1-7.

The specimen here figured, which appears to be from the basal portion of a small leaf, I am not able to distinguish from specimens figured by Fontaine under the name of *Pterophyllum rajmahalense* Morris. Fontaine's material came from Douglas County, Oregon, where it is said to be one of the most abundant species present. It is said to be somewhat less robust than the specimens described by Morris from the Rajamahal series of India. Fontaine states that the substance of the leaflets is thick and the veins are difficult to count, though by close study of a great many specimens he has made out the number as averaging about 15. In the present example the substance of the leaflets is very thick and the nerves are obscure, almost obsolete in fact, and in the figure they have been somewhat accentuated.

The Rajamahal series of India, whence this species was first described, is held to be of Liassic age, while the Oregon locality is thought to be of the same age as the well-known Jurassic beds at Yorkshire, England—namely, Lower Oölite. According to Fontaine this species is the same as that described by Heer,<sup>1</sup> under the name of *Pterophyllum sensinovianum*, from the Jurassic of Siberia. If the determination of the position of the Matanuska localities is correct, it is another step in showing that this species has been a persistent, long-lived type.

*Occurrence*.—6698. Upper Matanuska Valley, Alaska, about  $\frac{3}{4}$  mile up the next to the lowest creek entering East Fork of Boulder Creek from the south.

**PTEROPHYLLUM AEQUALE (Brongniart) Nathorst.**

Plate 80, fig. 3.

*Pterophyllum aequale* (Brongniart) NATHORST, Floran vid Bjuf I, Sveriges geol. Medersökning, Ser. C, No. 27, 1878, p. 11; Floran vid Höganäs ock Helsingborg; Sveriges geol. Medersökning, Ser. C, No. 29, 1878, p. 18, pl. ii, fig. 13; Floran vid Bjuf II; Sveriges geol. Medersökning, Ser. C, No. 33, 1879, p. 67, pl. xv, figs. 6-10.—ZEILLER, Fl. Foss. Tonkin, 1902, pl. 49, figs. 4-7.

This species was originally described by Brongniart<sup>2</sup> in 1825 from Hör in Scania under the name *Nilssonia*? *æqualis*, and has subse-

<sup>1</sup> Heer, O., Fl. Foss. Aret., vol. 4, pt. 2 (Jura-Fl. Ostsiberiens u des Amurlandes), 1876, p. 105, pl. 24, fig. 8.

<sup>2</sup> Brongniart, Obs. sur. vég. foss. de Hore, Am. Sci. Nat. Paris, vol. 4, 1825, p. 219, pl. 12, fig. 6.

quently been found to be more or less abundant at other localities in southern Sweden (Bjuf, Högånäs, Bosharp, Bornholm) and has also been found in other widely separated parts of the world, including north Persia, Tonkin, China, Mongolia, Oregon, and now Alaska.

The specimen here figured is the basal portion of a leaf of some magnitude and is chiefly remarkable for the exceedingly thick petiole. This is stronger than is usually shown in this species, though occasionally it may reach nearly or quite this size, as may be seen in one of the specimens figured by Zeiller in his Tonkin flora (pl. 49, fig. 6). The size and angle of insertion of the leaflets is also the same as in the figure just referred to.

The specimen under consideration agrees very well with some of the figures given by Nathorst in his Bjuf flora (pl. 15, figs. 8, 10, etc.), except that the leaflets in the Swedish specimens are more nearly at right angles with the petiole than in ours, but the difference is of minor importance.

This form was noted by Möller<sup>1</sup> from Bornholm, but as it was a mere fragment its reference is questioned. The figure given of it shows it to have shorter and much more acute leaflets than is usual, and its reference may well be questioned.

Under this name Fontaine has figured a number of fine leaves from Douglas County, Oregon, but they have the leaflets broader, closer together, and at a less angle of insertion than the majority of specimens figured by Nathorst, Zeiller, and others from the Old World, but these variations are perhaps well within the limits of specific differentiation.

*Occurrence.*—6698. Upper Matanuska Valley, Alaska, about  $\frac{3}{4}$  mile up the next to the lowest creek entering the East Fork of Boulder Creek from the south.

**CTENOPHYLLUM ANGUSTIFOLIUM? Fontaine.**

Plate 80, fig. 2.

*Ctenophyllum angustifolium* FONTAINE in Ward, Status Mesozoic floras of the United States, U. S. Geol. Survey Monog. 50, 1905, p. 105, pl. 22.

This specimen is referred with some hesitation to Fontaine's species, which has heretofore been known only from the Jurassic of Douglas County, Oregon. It is very much smaller than many of the examples figured by Fontaine and should perhaps be described as new, but it is so fragmentary that the full lengths of the leaflets can not be determined with certainty. So far as can be made out it might well enough be either a small leaf of this species or the upper portion of a leaf of medium size, yet considering the differences it has been thought best to question the reference.

<sup>1</sup> Möller, H., Bidrag till Bornholms foss. flora, Gymnospermer, Kongl. Svenska Vetenskaps-Ak. Handl., vol. 36, 1903, p. 19, pl. 3, fig. 11.



*Occurrence*.—6698. Upper Matanuska Valley, Alaska, about  $\frac{3}{4}$  mile up the next to the lowest creek entering the East Fork of Boulder Creek from the south.

**NILSSONIA POLYMORPHA** Schenk.

Plate 81, fig. 4.

*Nilssonia polymorpha* SCHENK, Foss. flora Grenzschildens d. Koupers u. Lias Frankens, 1867, p. 127, pl. 29; pl. 30, figs. 1-5.—NATHORST, Bidrag till Sveriges foss. flora, Kongl. Svenska Vetenskaps-Ak. Handl., vol. 14, 1876, p. 40, pl. 8, figs. 2-15; pl. 9; pl. 10; pl. 11.

This species, as may be seen in the two papers above quoted by Schenk and Nathorst, is an extremely variable one, showing a great range in size and outline of the leaf; in fact, the diversity is so great that it would seemingly do no harm to divide the species up at least into a number of well-marked forms, as, indeed, had been done before the species was defined by Schenk, especially if it could be shown that there were any stratigraphic relations established for the several forms. But, be this as it may, there are no data available in this country that would make such a course possible; in fact, the only specimen contained in the present collection is the one here figured which is a mere fragment from the middle of a medium-sized leaf with entire margins.

*Occurrence*.—6700. Upper Matanuska Valley, Alaska. Crest of spur between first and second tributaries entering East Fork of Boulder Creek above its mouth. Elevation, 4,780 feet.

**PAGIOPHYLLUM FALCATUM** Bartolin.

Plate 81, fig. 1.

*Pagiophyllum falcatum* BARTOLIN, Nogle i den bornholmske Juraformation forekommende Planteforsteninger.—MÖLLER, Bildrag till Bornholms fossila flora, Gymnospermer, Kongl. Svenska Vetenskaps-Ak. Handl., vol. 36, 1902, p. 32, pl. 5, fig. 13.

The Alaskan material includes a number of small branches and branchlets that appear to be best referred to this species. They are slightly smaller than the original species given by Bartolin, but are indistinguishable from the fragments figured by Möller, who, however, has questioned their reference to Bartolin's species.

*Occurrence*.—6700. Upper Matanuska Valley, Alaska. Crest of spur between first and second tributaries entering East Fork of Boulder Creek above its mouth. Elevation, 4,780 feet.

## EXPLANATION OF PLATES.

NOTE.—The figures in these plates were all made natural size, but by an unfortunate error they have been slightly reduced.

## PLATE 79.

*Otozamites pterophylloides* Brongniart. Cat. No. 34,994, U.S.N.M.

## PLATE 80.

FIG. 1.—*Pterophyllum rajmahalense* Morris. Cat. No. 34,995, U.S.N.M.

2.—*Ctenophyllum angustifolium*? Fontaine. Cat. No. 34,996, U.S.N.M.

3.—*Pterophyllum aequale* (Brongniart) Nathorst. Cat. No. 34,997, U.S.N.M.

## PLATE 81.

FIG. 1.—*Pagiophyllum falcatum* Bartolin. Cat. No. 34,998, U.S.N.M.

2.—*Sagenopteris*?, species. Cat. No. 34,999, U.S.N.M.

3.—*Cladophlebis hirta*? Möller. Cat. No. 35,000, U.S.N.M.

4.—*Nilssonina polymorpha* Schenk. Cat. No. 35,001, U.S.N.M.

5, 6.—*Otozamites bornholmiensis*? Möller. Cat. Nos. 35,002, 35,003, U.S.N.M.

## PLATE 82.

FIGS. 1-4.—*Dictyophyllum nilssoni* (Brongniart) Göppert. Cat. Nos. 35,004, 35,005, 35,006, 35,007, U.S.N.M.

5.—*Otozamites*, species. Cat. No. 35,008, U.S.N.M.